

What is claimed is:

1           1.     An image reading method for reading lines on a surface  
2     of an object to be read in a sub-scanning direction and for  
3     outputting image signals obtained by reading said lines to be read,  
4     comprising:

5           a step of setting a number M of lines (said M is a natural  
6     number being not less than two) that have to be simultaneously  
7     read, an interval N (said N is a natural number being not less  
8     than two) among said lines that have to be simultaneously read  
9     and which is represented by lines to be read and a number L of  
10    lines (said L is a natural number) by which each of said lines  
11    to be read moves, every time simultaneous reading is completed,  
12    from said lines whose reading has been completed, to a value that  
13    can avoid omission of reading when a sequential single reading  
14    is performed from a first line to be read on said surface of said  
15    object to a last line to be read on said surface of said object  
16    and to a value at which said lines to be read on said surface of  
17    said object can be all read,

18           a step of reading said lines to be read on said surface of  
19    said object to be read by moving said lines by a number of said  
20    lines to be read in a sub-scanning direction when said  
21    simultaneous reading has been completed and by repeating said  
22    simultaneous reading on subsequent lines to be read; and

23           a step of outputting image data obtained by reading said  
24    lines to be read.

1           2.     The image reading method according to Claim 1,  
2     wherein values of said M, said N and said L are set to a value

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3 at which there is no omission of reading lines to be read occurring  
4 in said single time reading operation.

1 3. The image reading method according to Claim 2,  
2 wherein said first line to be read on said surface of said object  
3 is a line existing backward, from a first line to be normally read  
4 on said surface of said object, by predetermined numbers of lines  
5 to be read which is determined based on values of said M, said  
6 N, and said L, in said sub-scanning direction, while said last  
7 line to be read is a line existing forward, from a last line to  
8 be normally read on said surface of said object, by predetermined  
9 numbers of lines to be read which is determined based on values  
10 of said M, said N, and said L, in said sub-scanning direction and  
11 wherein image signals of said lines to be read are image signals  
12 of said first line to be normally read to said last line to be  
13 normally read.

1 4. An image reading apparatus for reading lines to be  
2 read on a surface of an original document in a sub-scanning  
3 direction and outputting image signals obtained by reading said  
4 lines to be read, comprising:

5 a reading unit having light sensing devices that are able  
6 to simultaneously read M (said M is a natural number being not  
7 less than two) pieces of lines to be read which are said lines  
8 to be read existing on said surface of said original document and  
9 which are different lines in said sub-scanning direction, each  
10 existing apart by N (said N is a natural number being not less  
11 than two) pieces of lines in said sub-scanning direction;

12 a moving unit to move said original document and said

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13 reading unit, every time said lines are simultaneously read, by  
14 L (said L is a natural numbers) pieces of said lines to be read,  
15 in said sub-scanning direction;

16 an image signal outputting unit to output image signals of  
17 said lines to be read which have been read by said reading unit  
18 in order of reading in said sub-scanning direction; and

19 wherein values of said M, said N, and said L are set to a  
20 value at which lines on said surface of said original document  
21 are able to be read without omission of reading lines when  
22 simultaneous and sequential reading operations are performed from  
23 a first line to be read to a last line to be read on said surface  
24 of said original document.

1 5. The image reading apparatus according to Claim 4,  
2 wherein values of said M, said N, and said L are set so that M  
3  $\geq 2$ ,  $N \geq 1 + M$ , and  $L = N - 1$ .

1 6. The image reading apparatus according to Claim 5,  
2 wherein value of said N is set so that  $N = 1 + M$ .

1 7. The image reading apparatus according to Claim 4,  
2 wherein values of said M, said N, and said L are set so that M  
3  $\geq 2$ ,  $L = M$ , and that a greatest common measure of values of said  
4 L and said N, equals one.

1 8. The image reading apparatus according to Claim 4,  
2 wherein values of said M, said N, and said L are set so that M  
3  $\geq 2$ ,  $1 < L \leq M$  and that a greatest common measure of values of  
4 said L and said M equals one.

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1           9.     The image reading apparatus according to Claim 8,  
2     wherein values of said M and said L are set so that  $M = L$ .

1           10.    The image reading apparatus according to Claim 8,  
2     wherein values of said M and said L are set so that  $1 < 1 + L <$   
3      $1 + M$ .

1           11.    The image reading apparatus according to Claim 4,  
2     wherein said image outputting unit includes:  
3           an analog to digital converting circuit to analog to digital  
4     convert image signals of M pieces of lines to be read which have  
5     been output from said reading unit;  
6           a storing device to store pixel data obtained by conversion  
7     by said analog to digital converting circuit; and  
8           a reading control circuit to read said pixel data stored  
9     in said storing device in order of reading in said sub-scanning  
10    direction.

1           12.    The image reading apparatus according to Claim 11,  
2     wherein said reading unit starts said reading operation from a  
3     line existing backward in said sub-scanning direction by a  
4     predetermined number of lines to be read that are determined based  
5     on values of said M, said N, and said L from said first line to  
6     be normally read and performs reading operations up to a line  
7     existing forward in said sub-scanning direction by said  
8     predetermined number of lines to be read that is determined based  
9     on values of said M, said N, and said L and wherein said storing  
10    device stores only said pixel data obtained by reading lines to  
11    be normally read and output from said analog to digital converting

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12 circuits.

1           13. The image reading apparatus according to Claim 12,  
2 wherein said reading device is constructed as a color reading  
3 device, and wherein an image processing circuit for gray-level  
4 correction is provided between said storing device and said analog  
5 to digital converting circuit making up said image signal  
6 outputting.

1           14. An image reading apparatus for reading lines to be  
2 read on a surface of an original document in a sub-scanning  
3 direction and outputting image signals obtained by reading said  
4 lines to be read, comprising:

5           a reading means having light sensing devices that are able  
6 to simultaneously read M (said M is a natural number being not  
7 less than two) pieces of lines to be read which are said lines  
8 to be read existing on said surface of said original document and  
9 which are different lines in said sub-scanning direction, each  
10 existing apart by N (said N is a natural number being not less  
11 than two) pieces of lines in said sub-scanning direction;

12           a moving means to move said original document and said  
13 reading means, every time said lines are simultaneously read, by  
14 L (said L is a natural numbers) pieces of said lines to be read,  
15 in said sub-scanning direction;

16           an image signal outputting means to output image signals  
17 of said lines to be read which have been read by said reading means  
18 in order of reading in said sub-scanning direction; and

19           wherein values of said M, said N, and said L are set to a  
20 value at which lines on said surface of said original document

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21 are able to be read without omission of reading lines when  
22 simultaneous and sequential reading operations are performed from  
23 a first line to be read to a last line to be read on said surface  
24 of said original document.

1 15. The image reading apparatus according to Claim 14,  
2 wherein said image outputting means includes:  
3 an analog to digital converting circuit to analog to digital  
4 convert image signals of M pieces of lines to be read which have  
5 been output from said reading means;  
6 a storing device to store pixel data obtained by conversion  
7 by said analog to digital converting circuit; and  
8 a reading control circuit to read said pixel data stored  
9 in said storing device in order of reading in said sub-scanning  
10 direction.

1 16. The image reading apparatus according to Claim 15,  
2 wherein said reading means starts said reading operation from a  
3 line existing backward in said sub-scanning direction by a  
4 predetermined number of lines to be read that are determined based  
5 on values of said M, said N, and said L from said first line to  
6 be normally read and performs reading operations up to a line  
7 existing forward in said sub-scanning direction by said  
8 predetermined number of lines to be read that is determined based  
9 on values of said M, said N, and said L and wherein said storing  
10 device stores only said pixel data obtained by reading lines to  
11 be normally read and output from said analog to digital converting  
12 circuits.

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1           17.   The image reading apparatus according to Claim 21 or  
2   Claim 16, wherein said reading device is constructed as a color  
3   reading device, and wherein an image processing circuit for  
4   gray-level correction is provided between said storing device and  
5   said analog to digital converting circuit making up said image  
6   signal outputting.

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